DOI: 10.14744/ejmi.2019.49186
EJMI 2020;4(3):327–331

Research Article

Comparison of Analgesic Effects of Pure Bupivacaine and Morphine Added as Bupivacaine Adjuvant in USG Guided Adductor Canal Block Following Total Knee Arthroplasty

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Abstract

Objectives: Total knee arthroplasty (TKA) is an operation that causes severe postoperative pain. Adductor canal block (ACB) is separated from the other peripheral blocks as a method that can provide analgesia by sensory blockade only. The aim of this study was to compare the analgesic effect of morphine-bupivacaine with pure bupivacaine in USG-guided ACB after TKA.

Methods: Sixty patients aged between 40-80 years with ASA I-III physical status who were scheduled for TKA surgery in our hospital were included in this prospective randomized study. Patients were randomly divided into two groups as Group BM (bupivacaine+morphine) and Group B (bupivacaine) by closed envelope method, and then the groups were compared with each other.

Results: In Group BM, compared to Group B, there was a significant decrease in visual analogue scale (VAS) values during rest and movement at 8th hour, 12-24 hours time zone analgesic consumption and additional analgesia usage.

Conclusion: We conclude that the morphine added to bupivacaine in the adductor canal block reduces the VAS value at 8th hour and analgesic consumption.

Keywords: Adductor canal block, arthroplasty, morphine

Cite This Article: *Turkoglu K, Yildiz I, Engin Ozturan K, Isik C, Karagoz I, Yoldas H, et al. Comparison of Analgesic Effects of Pure Bupivacaine and Morphine Added as Bupivacaine Adjuvant in USG Guided Adductor Canal Block Following Total Knee Arthroplasty. EJMI 2020;4(3):327–331.*

Total knee arthroplasty (TKA) is an operation carried out in more advanced age groups.[1] Severe pain occurs post-operatively which is hard to resolve with oral analgesics. Pain can lead to serious cardiac, pulmonary and renal problems due to endocrine, metabolic and inflammatory responses.[2] Inadequate pain control after knee surgery prevents early mobilization of the knee joint.[3] Adhesions, capsular contracture and muscle atrophy may develop in the knee joint. This situation may prevent early physiotherapy, which is the most important component of knee rehabilitation, and therefore adversely affect morbidity and mortality.[4] Pain control increase satisfactory results of these surgeries.

Different methods are used for post-TKA pain control. Increased use of ultrasonography (USG) and less seen hemodynamic and respiratory complications in recent years increased usage of peripheral block.[5] Adductor canal block (ACB) is separated from the other peripheral blocks as a method that can provide analgesia by sensory blockade only.[6]

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Submitted Date: August 06, 2019 **Accepted Date:** September 09, 2019 **Available Online Date:** June 05, 2020

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Many adjuvant agents have been used to provide analgesia in the lower doses of local anesthetics, reduce the risk of toxicity, shorten the time to start the operation, provide analgesia in postoperative period and ultimately improve the quality of the anesthesia. Corticosteroids, anti-inflammatory drugs, morphine and epinephrine are some of these adjuvants.[7,8]

In this study, we aimed to compare the analgesic effect of morphine-bupivacaine with pure bupivacaine in USG-guided ACB after TKA.

Methods

After the obtaining approval from institutional ethics committee (approval date: 06/02/2018, decision number: 2017/199), a total of 60 patients aged between 40-80 years with ASA I-III physical status who were scheduled for TKA surgery under spinal anesthesia were included in the study. The patients were double blinded and randomly divided into two groups as Group BM (bupivacaine+morphine) and Group B (bupivacaine) by randomized, prospective and closed envelope method. Demographic data of all patients (gender, age, weight, height, BMI, additional diseases) were recorded before surgery, and then the groups were compared with each other. Patients who pregnant women, patients with severe cardiac, pulmonary, hepatic, renal disease, history of chronic opioid use and pain syndrome, not suitable for regional anesthesia (bleeding diathesis, procedure site infection), hypersensitivity to the drugs were excluded from the study. The study was conducted in accordance with the principles of the Declarations of Helsinki. The necessary written consents were taken from all participants.

The patients were taken to the operation room without premedication and electrocardiography (ECG), heart rate (HR), non-invasive blood pressure (NIBP) and peripheral oxygen saturation (SpO_2) values were monitored. Patients in both groups were placed in the sitting position for spinal anesthesia. After the sterilized area has been covered, spinal anesthesia was performed by injection of 15 mg hyperbaric bupivacaine (Bustesin® %0.5 Spinal heavy VEM, İstanbul) to the intrathecal area at L3-4 or L4-5 level with a 25 G "Quincke" tipped spinal needle (Spinocan, Braun, Germany). All patients were given oxygen at 4-6 lt/min until the end of the operation. The sensory block and motor block levels were controlled at 2 min intervals and when the sensory block reached the T10 dermatome site, the surgery was started.

After the operation, ECG, HR, NIBB and SpO_2 values were monitored in the postoperative recovery unit. The area was covered after sterilization. While the patient was in the supine position, the patient's operated leg was slightly externally rotated. After aseptic conditions were achieved, the linear ultrasound probe (L38/10-5 mHz Transducer, SonoSite, Inc. Bothell, WA 98021 USA) was placed at approximately mid-point between the inguinal fold on the anterior aspect of the thigh and the medial condyle of the knee. The arteria femoralis was visualized in the adductor duct under the Sartorius muscle. 1-2 cm lateral to the ultrasound probe in plane technique, Entry was made with 22G 80-100 mm block needle (Pajunk, SonoPlex Stim cannulla, U.S.A) by in plane technique from 1-2 cm lateral of the ultrasound probe. The needle was advanced under the sartorius muscle to the lateral of arterial femoralis and the nervus saphenous. ACB was applied to the patients in Group BM with a mixture of 0.5% Bupivacaine (Bustesin® % 0,5 Vem, Turkey) 10 mL, Morphine HCL (Morphine® 0.01 g/mL, Galen, Turkey) 1 mL and 0.9% NaCl 9 mL with 20 ml. ACB was applied to the patients in Group B with a mixture of 0.5% Bupivacaine 10 mL and 0.9% NaCl 10 mL with 20 mL. During injection, the distribution of local anesthesia was easily observed under ultrasound. After the administration; ECG, HR, NIBP and SpO_2 values were recorded at 10-minute intervals in the postoperative care unit for at least 1 hour.

IV Patient Controlled Analgesia (PCA) was used for all patients, which contains Tramadol HCL (Tramosel® 100 mg/2 mL Haver Pharma Drug Inc.,Turkey) at a concentration of 5 mg/mL, without continuous opioid infusion and allowing a maximum dose of 400 mg in 24 hours. Patients were asked to press the button when they had pain for bolus 10 mg Tramadol HLC dose adjusted with a lock interval of 20 minutes. Resting visual analogue scale (VAS) values at 0. 1. 2. 4. 8. 12. 16. and 24th hour (VAS 0=no pain, 10=unbearable pain), patient satisfaction level (0=bad, 1=moderate, 2=good, 3=perfect), analgesic consumption (Tramadol HCL) in 0-1, 1-12, 12-24 hour zones and possible side effects were evaluated for 24 hours in terms of nausea, vomiting and pruritus. When VAS was over 4, 50 mg Pethidine (Aldolan 100 mg/2 ml amp Liba Laboratories Inc./ Turkey) in 100 ml saline was given intravenously as analgesic rescuer. Patients with nausea and vomiting were given intravenous administration of 4 mg ondansetron (Ondaren Ampul 2 ml/4 mg VEM, Turkey).

Sample Size Calculation

Sample size estimation was performed based on the study of Jenstrup et al.[9] (Average morphine consumption control values 56±26 mg). The sample size estimations revealed that for detection of a 35% change in morphine consumption (19 mg), the sample size should be at least 25 patients with an error margin of 0.05 (α=0.05) and a power of 95%. Based on these results, 30 patients were included in the study, with

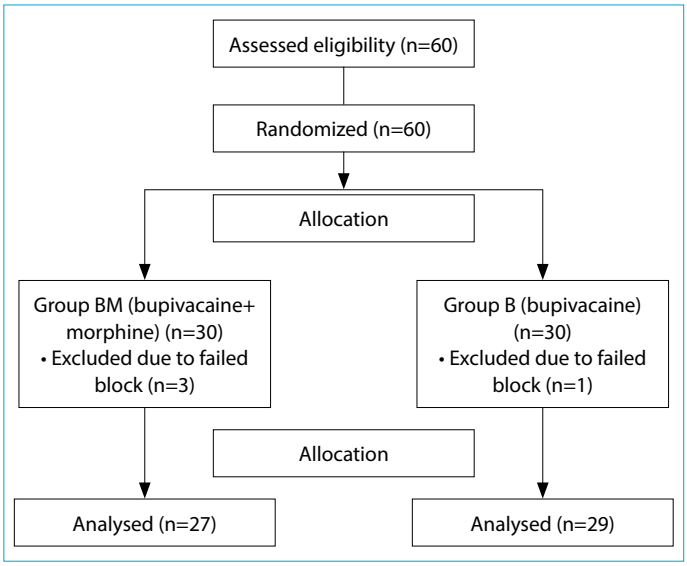

Figure 1. Flow chart of the study.

an estimated exclusion rate of approximately 15%. Sample size was calculated using G power 3.1.9.2 Calculator.

Statistical Method

SPSS 22.0 program was used for data analysis. Differences between categorical variables between Group B and Group BM were compared with cross tables and chi-square independence tests. Also, normality tests were applied for continuous variables. The t-test was applied for independent groups to differences between the two groups for the normally distributed variables. Continuous variables not normally distributed were also compared with non-parametric Mann Whitney U test. The data distributions of each group were summarized with summary statistics. Statistical tests were interpreted with $p<0.05$ significance level.

Results

The study was completed with 56 patients because of failed block in 3 patients in Group BM and 1 patient in Group B (Fig. 1). There was no statistically significant difference between the groups in terms of demographic data ($p>0.05$) (Table 1).

Resting pain assessment scores were compared. It was significantly lower in Group BM at 8th hour ($p<0.05$) (Table 2).

In both groups, tramadol consumption levels were examined. No significant difference was observed in the first 12 hours. However, at 12-24th hour and total consumption amount were significantly lower in Group BM ($p<0.05$) (Table 3).

Total number of patients used pethidine and analgesic consumption in the 12-24. hour was significantly lower in GroupBM ($p<0.05$) (Table 4).

Postoperative side effects were compared. Nausea was detected in 7 patients in Group BM and 2 patients in Group B in the first 12 hours ($p<0.05$). No statistically significant difference was found between the two groups in terms of vomiting and itching ($p>0.05$).

Table 1. Descriptive statistics for group B and group BM

Variables	Group B	Group BM	p
Gender, n (%)			
Woman	12 (41.4)	8 (29.6)	0.359
Men	17 (58.6)	19 (70.4)	
Age (years)	66.45±9.65	70.19±4.67	0.070
Weight (kg)	82.28±14.32	80.33±15.01	0.622
Height (cm)	161.48±8.52	161.15±10.95	0.899
BMI (kg/m^2)	31.7±6.43	31.11± 6.82	0.741
ASA score	2.03±0.63	2.11±0.42	0.597
Tourniquet time (min.)	84.48±19.61	82.78±11.04	0.688
Surgery time (min.)	77.62±18.89	76.67±11.52	0.819

ASA: American Society of Anesthesiologists; BMI: Body mass index. Data are presented as number (%) or mean±standard deviation.

Table 2. Resting visual analogue scale (VAS) scores for group B and group BM

Follow-up time	Group B	Group BM	p
Hour 0	0 (0-0)	0 (0-0)	1.000
Hour 1	0 (0-0)	0 (0-0)	1.000
Hour 2	0 (0-0)	0 (0-2)	0.300
Hour 4	3 (1-7)	3 (0-5)	0.804
Hour 8	5 (3-7)	4 (1-6)	0.002*
Hour 12	5 (3-7)	5 (1-7)	0.822
Hour 16	4 (2-6)	4 (1-6)	0.891
Hour 20	3 (1-4)	3 (1-5)	0.670
Hour 24	2 (0-4)	2 (0-4)	0.620

According to the Mann Whitney U test, statistically significant difference at the level of $p<0.05$. Data are presented as median (min.-max.).

Table 3. Tramadol consumption according to follow-up times (mg)

Follow-up time	Group B	Group BM	p
0-1 hour	0 (0)	0 (0)	-
1-12 hour	107.4±25.8	99.3±31.4	0.291
12-24 hour	157.8±21.8	140.0±33.5	0.022*
Total	264.8±33.6	239.3±58.8	0.049*

*Statistically significant difference at the $p<0.05$ significance level for independent groups t-test. Data are presented as mean±standard deviation.

Discussion

This study showed that; morphine, which is added to bupivacaine in ACB after USG guided TKA, decreases resting

Table 4. Number of patients used pethidine according to follow-up periods

Follow-up time	Group B (n=29)	Group BM (n=27)	p
0-1 hour	0	0	-
1-12 hour	6 (20.6)	5 (18.5)	0.282
12-24 hour	10 (34)	6 (22.22)	0.024*
Total	16 (55.17)	11 (40.7)	0.048*

*Statistically significant difference at the p<0.05 significance level for independent groups t-test. Data are presented as number (%).

VAS score at the 8th hour and decreases total analgesic use and additional analgesic consumption. Adductor canal is located in a part of the middle third of the thigh, approximately 12-14 cm proximal of thight. It is a triangular structure consisting of quadriceps muscle (especially vastus medialis) in anterolateral, sartorius muscle in medial and adductor magnus muscle in posterior. It is also known as the Hunter canal or lower sartorial canal. It is an aponeurotic and intermuscular tunnel. Femoral artery, femoral vein, posterior branch of obturator nerve and other branches of femoral nerve; especially the saphenous nerve and the vastus medialis nerve are located in this canal.[10] ACB, a new technique, is the blocking of the saphenous nerve, the sensory branch of the femoral nerve, in the adductor canal. Also the medial femoral cutaneous nerve, articular branches of the obturator nerve and the vastus medialis, the second largest sensory branch of the femoral nerve, are also affected. In ADC, the target is the sensory fibers.[11] It creates sensory blockage without motor block in knee and inferior to knee level surgery. In postoperative analgesia studies, it has been shown to be effective especially in patients with TKA surgery.[12,13] Peripheral nerve block compared with iv opioid use and epidural analgesia; it was reported to be more effective than opioid use, and its efficacy was equivalent or more significant with epidural analgesia and the incidence of side effects was reported to be low.[14,15] Hanson et al.[16] in his study, ACB was performed for multimodal analgesia to patients undergoing medial meniscopathy surgery with general anesthesia and they showed that pain scores and opioid consumption were significantly lower compared to the control group. Akkaya T. et al.[17] in their study performed general anesthesia to two groups for arthroscopic knee surgery. ACB was administered in addition to one of the groups. They found a significant decrease in VAS scores and opioid consumption during the postoperative period in the ACB applied group. VAS values were reported to be 4 or less on average in studies.[18–20] In our study, we found the mean VAS values 5 and lower. When we compared the other studies in the literature, we thought that the VAS scores were lower in some studies due to routine use of oral, intravenous non-opioid analgesics and the higher doses of opioid infusion in addition to the ACB.

Preemptive analgesia, systemic analgesics (opioids, acetaminophen, COX-2 inhibitors, NMDA antagonists), neuraxial techniques, peripheral nerve blocks, multimodal analgesia methods are used in postoperative pain management.[5] Opioids have an important place in the management of acute postoperative pain because of their effective analgesia and easy application. However; cardiac, respiratory, urinary, gastrointestinal and neurological complications are frequently seen due to high doses. Parenteral opioids and NSAID's, used alone or combined, were shown to provide optimal systemic analgesia at rest, but they failed to relieve postoperative pain occurring with movement.[21] Therefore, 60% of patients have severe pain and 30% have moderate pain.[22] Kelebek et al.[23] added morphine in the brachial plexus block and reported that the duration of block initiation was shorter, the sedation scores were higher and the duration of postoperative analgesia was longer with no chance on hemodynamic parameters. In our study, we also found that total opioid consumption and additional analgesic consumption were less in group with morphine added. It has been reported in the literature that neurological damage may occur due to peripheral nerve block.[24] In our study, we did not experience any neurological damage in the perioperative and postoperative period. We found that the frequency of nausea was higher in the morphine used group. We thought that this condition was due to the known nausea side effect of morphine.

Our limitation in this study is that we provide post-block analgesia only with bolus doses without continuous infusion with PCA device and we do not use routine additional oral or intravenous analgesics and antiemetic prophylaxis. In conclusion, after total knee arthroplasty, morphine added to bupivacaine in the adductor canal block reduces tramadol consumption and decreases resting VAS score at the 8th hour.

Disclosures

Ethics Committee Approval: Bolu Abant Izzet Baysal University Medical Faculty, Clinical Studies Local Ethics Committee Date and number: 06/02/2018, 2017/199.

Peer-review: Externally peer-reviewed.

Conflict of Interest: The authors have no conflicts of interest to report.

Authorship Contributions: Concept – K.T., I.Y.; Design – K.T., I.Y.; Materials – K.E.O., C.I.; Data collection and/or processing – I.K., H.Y., K.E.O.; Analysis and/or interpretation – M.B., A.D., C.I.; Literature search – K.T., A.D.; Writing – K.T., I.Y.; Critical review – A.D., I.Y., C.I.

References

1. Singh JA, Kwoh CK, Boudreau RM, Lee GC, Ibrahim SA. Hospital volume and surgical outcomes after elective hip/knee arthroplasty: a risk-adjusted analysis of a large regional database. Arthritis Rheum 2011;63:2531–9.
2. Sommer M, de Rijke JM, van Kleef M, Kessels AG, Peters ML, Geurts JW, et al. The prevalence of postoperative pain in a sample of 1490 surgical inpatients. Eur J Anaesthesiol 2008;25:267–74.
3. Backes JR, Bentley JC, Politi JR, Chambers BT. Dexamethasone reduces length of hospitalization and improves postoperative pain and nausea after total joint arthroplasty: a prospective, randomized controlled trial. J Arthroplasty 2013;28:11–7.
4. Bade MJ, Stevens-Lapsley JE. Early high-intensity rehabilitation following total knee arthroplasty improves outcomes. J Orthop Sports Phys Ther 2011;41:932–41.
5. Akkaya A, Yildiz I, Tekelioglu UY, Demirhan A, Bayir H, Ozlu T, et al. Dexamethasone added to levobupivacaine in ultrasound-guided tranversus abdominis plain block increased the duration of postoperative analgesia after caesarean section: a randomized, double blind, controlled trial. Eur Rev Med Pharmacol Sci 2014;18:717–22.
6. Shah NA, Jain NP. Is continuous adductor canal block better than continuous femoral nerve block after total knee arthroplasty? Effect on ambulation ability, early functional recovery and pain control: a randomized controlled trial. J Arthroplasty 2014;29:2224–9.
7. Jaeger P, Zaric D, Fomsgaard JS, Bjerregaard J, Gyrn J, Mathiesen O, et al. Adductor canal block versus femoral nerve block for analgesia after total knee arthroplasty: a randomized, double-blind study. Reg Anesth Pain Med 2013;38:526–32.
8. Demirhan A, Tekelioglu UY, Akkaya A, Bilgi M, Apuhan T, Karabekmez FE, et al. Effect of pregabalin and dexamethasone addition to multimodal analgesia on postoperative analgesia following rhinoplasty surgery. Aesthetic Plast Surg 2013;37:1100–6.
9. Jenstrup MT, Jæger P, Lund J, Fomsgaard JS, Bache S, Mathiesen O, et al. Effects of adductor-canal-blockade on pain and ambulation after total knee arthroplasty: a randomized study. Acta Anaesthesiol Scand 2012;56:357–64.
10. Horn JL, Pitsch T, Salinas F, Benninger B: Anatomic basis to the ultrasound-guided approach for saphenous nerve blockade. Reg Anesth Pain Med 2009;34:486–9.
11. Grevstad U, Mathiesen O, Valentiner LS, Jaeger P, Hilsted KL, Dahl JB. Effect of adductor canal block versus femoral nerve block on quadriceps strength, mobilization, and pain after total knee arthroplasty: a randomized, blinded study. Reg Anesth Pain Med 2015;40:3–10.
12. Turhan KS, Akmese R, Ozkan F, Okten FF. Comparison of low-dose spinal anesthesia and single-shot femoral block combination with conventional dose spinal anesthesia in outpatient arthroscopic meniscus repair. Eur Rev Med Pharmacol Sci 2015;19:1489–97.
13. Macrinici GI, Murphy C, Christman L, Drescher M, Hughes B, Macrinici V, et al. Prospective, Double-Blind, Randomized Study to Evaluate Single-Injection Adductor Canal Nerve Block Versus Femoral Nerve Block: Postoperative Functional Outcomes After Total Knee Arthroplasty. Reg Anesth Pain Med 2017;42:10–6.
14. Davies AF, Segar EP, Murdoch J, Wright DE, Wilson IH. Epidural infusion or combined femoral and sciatic nerve blocks as perioperative analgesia for knee arthroplasty. Br J Anaesth 2004;93:368–74.
15. Barrington MJ, Olive D, Low K, Scott DA, Brittain J, Choong P. Continuous femoral nerve blockade or epidural analgesia after total knee replacement: a prospective randomized controlled trial. Anesth Analg 2005;101:1824–9.
16. Hanson NA, Derby RE, Auyong DB, et al. Ultrasound-guided adductor canal block for arthroscopic medial meniscectomy: a randomized, double-blind trial. Can J Anaesth 2013;60:874–80.
17. Akkaya T, Ersan O, Ozkan D, et al. Saphenous nerve block is an effective regional technique for post-menisectomy pain. Knee Surg Sports Traumatol Arthrosc 2008;16:855–8.
18. Memtsoudis SG, Yoo D, Stundner O, Danninger T, Ma Y, Poultsides L, et al. Subsartorial adductor canal vs femoral nerve block for analgesia after total knee replacement. Int Orthop 2015;39:673–80.
19. Wiesmann T, Piechowiak K, Duderstadt S, Haupt D, Schmitt J, Eschbach D, et al. Continuous adductor canal block versus continuous femoral nerve block after total knee arthroplasty for mobilisation capability and pain treatment: a randomised and blinded clinical trial. Arch Orthop Trauma Surg 2016;136:397–406.
20. Machi AT, Sztain JF, Kormylo NJ, Madison SJ, Abramson WB, Monahan AM, et al. Discharge Readiness after Tricompartment Knee Arthroplasty: Adductor Canal versus Femoral Continuous Nerve Blocks-A Dual-center, Randomized Trial. Anesthesiology 2015;123:444–56.
21. Fowler SJ, Symons J, Sabato S, Myles PS. Epidural analgesia compared with peripheral nerve blockade after major knee surgery: a systematic review and meta-analysis of randomized trials. Br J Anaesth 2008;100:154–64.
22. Sinatra RS, Torres J, Bustos AM. Pain management after major orthopaedic surgery: current strategies and new concepts. J Am Acad Orthop Surg 2002;10:117–29.
23. Kelebek N, Uçkunkaya N, Tokat O. Perinöral morfinin brakiyal pleksus blokajında anestezi ve analjezi üzerine etkisi XXXIV. Anesteziyoloji ve Reanimasyon Kongresi. Kuşadası-Türkiye, 2000; 471.
24. Barrington MJ, Watts SA, Gledhill SR, Thomas RD, Said SA, Snyder GL, et al. Preliminary results of the Australasian Regional Anaesthesia Collaboration: a prospective audit of more than 7000 peripheral nerve and plexus blocks for neurologic and other complications. Reg Anesth Pain Med 2009;34:534–41.